DOCUMENT RESUME

ED 405 851 IR 018 300

TITLE	Information and Communication Technologies in Development: a UNESCO Perspective.
INSTITUTION	United Nations Educational, Scientific, and Cultural Organization, Paris (France).
REPORT NO	CII-96-WS/6
PUB DATE	Dec 96
NOTE	49p.
PUB TYPE	Reports - Evaluative/Feasibility (142)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Change; *Computer Networks; Developing Nations; *Development; Elementary Secondary Education; Foreign Countries; Government (Administrative Body); Information Dissemination; Information Industry; Information Management; *Information Technology; Internet; Libraries; Mass Media; Public Agencies; Schools; *Technological Advancement; *Telecommunications
IDENTIFIERS	*Barriers to Implementation; *UNESCO

ABSTRACT

The rapid development and use of information and communication technologies (ICTs) has a direct and dramatic impact on all aspects of life. The traditional distinctions among media, publishing, telecommunications, computing, and information services have become blurred, and new paradigms for creation, dissemination, and exploitation of knowledge continue to evolve. In this transformation from an "industrial" to an "information" society, UNESCO (United Nations Educational, Scientific, and Cultural Organization) has a unique intellectual and ethical mandate to make these new technologies work for social, cultural, and economic development, in the interest of democracy and peace. This report focuses on the social, cultural, ethical, and legal implications of the information revolution, with emphasis on its impact in areas of public concern such as education, libraries, cultural production and exchange, the media, research, and environmental management. The report discusses policy aspects of electronic media, and experiences and proposals relevant to efforts of public institutions, governments, and other development actors to implement these evolving technologies in the developing world. The report contains five sections: (1) Introduction; (2) Technology for Development or Development for Technology? (3) Key Priority Areas and Future Possibilities; (4) Constraints To Realizing the Potential of ICTs in Developing Countries; and (5) Action Needed To Release the Developmental Potential of ICTs. (Contains 21 references.) (Author/SWC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 405 851

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)
☐ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

CII-96-WS/6

Information and Communication Technologies in Development: A UNESCO Perspective

United Nations Educational
Scientific and Cultural Organization

Paris, 1996

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
F. Zanuttini
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

IR018 300

Original: English

CII-96//WS/6
December 1996

Information and Communication Technologies in Development: A UNESCO Perspective

Prepared by

the UNESCO Secretariat

United Nations Educational,
Scientific and Cultural Organization

This report was prepared to provide an input in UNESCO's fields of competence to the Working Group of the United Nations Commission on Science and Technology for Development (CSTD) on Information Technology for Development and to the International Telecommunication Union (ITU) Development Study Group 1. It presents a number of views and proposals voiced in recent UNESCO-sponsored forums concerning the challenge of Information Highways for development. The official position of the Organization can be found in the document entitled *UNESCO and an Information Society for All* referenced in this report.

Recommended catalogue entry:

Information and Communication Technologies in Development: A UNESCO Perspective / prepared by the UNESCO Secretariat. - Paris : UNESCO, 1996. - iv, 42p. ; 30 cm. - (CII-96/WS/6)

I - Title
II - UNESCO

© UNESCO, 1996

PREFACE

The rapid development and use of information and communication technologies is having a direct and dramatic impact on all aspects of life. The traditional distinctions among media, publishing, telecommunications, computing and information services are becoming blurred, and new paradigms for creation, dissemination and exploitation of knowledge are evolving. In this transformation from an "industrial" to an "information" society, UNESCO has a unique intellectual and ethical mandate to make these new technologies work for social, cultural and economic development, in the interest of democracy and peace.

This report is a follow-up to the 1995 joint study of the International Telecommunication Union (ITU) and UNESCO on *The Right to Communicate: At What Price?*, which provided a valuable insight into the major economic and administrative problems encountered in this changing environment. The focus of the present report is rather on the social, cultural, ethical and legal implications of the information revolution, with emphasis on its impact in areas of public concern such as education, libraries, cultural production and exchange, the media, research and environmental management. Policy aspects of electronic media are also reviewed, for example concerning their impact on "fair use" and copyright, "the right to privacy", the "right of expression" and "universal access".

The report presents a number of experiences and proposals relevant to efforts of public institutions, governments and other development actors take advantage of these evolving technologies, particularly in the less-favored developing world. It can be seen as a contribution to UNESCO's continuing effort to promote dialogue and exchange of information on the role of information and communication technologies in decision-making to foster economic, social and cultural development for the benefit of all peoples and nations, without discrimination, injustice or marginalization.

TABLE OF CONTENTS

I. INTRODUCTION	**1**
II. TECHNOLOGY FOR DEVELOPMENT OR DEVELOPMENT FOR TECHNOLOGY?	**2**
III. KEY PRIORITY AREAS AND FUTURE POSSIBILITIES	**5**
• **Education**	**6**
• **Libraries**	**10**
• **Culture**	**12**
• **Mass Media**	**14**
• **Scientific Research**	**17**
• **Environment**	**19**
IV. CONSTRAINTS TO REALIZING THE POTENTIAL OF ICTs IN DEVELOPING COUNTRIES	**21**
• **Technological Constraints**	**22**
• **Financial Constraints**	**24**
• **Content and Interface Limitations**	**26**
• **Ethical and Legal Constraints**	**27**
• **Political and Institutional Constraints**	**29**
• **Human Resource Constraints**	**30**
• **Socio-Cultural Constraints**	**31**

V. ACTION NEEDED TO RELEASE THE DEVELOPMENTAL POTENTIAL OF ICTs 31

- Legal and Ethical Frameworks 32
- Incentives and Subsidies 34
- Public Domain and Public Access 36
- Technology Standards 38
- Training and Research 39
- Cooperation 39

REFERENCES 41

I. INTRODUCTION

1. Information and communication technologies (ICTs) have the potential to dramatically reshape and transform the ways in which people organize their lives, interact with each other and participate in the various spheres of society. These technologies form the basis for a radical shift from industrial/post-industrial definitions of development to a new paradigm based on the model of information societies. This shift promises to redefine the areas of work, learning and research, leisure and entertainment, participation and governance.

2. Much has already been written about how the ICTs are positively changing the world - the internationalization of trade and the development of a world economic market (comprised of regional networks); the globalization of culture and communication; the vastly expanded choices for people to access education, political participation, health care, government services, cultural and community activities, etc. Much has also been written on the negative aspects of ICTs - unduly privileging the "man-machine" relationship to the detriment of reflection, self-reliance, human relationships and personal capacity-building; increasing the chasm between the "haves" and "have nots"; encouragement of new types of exclusion and of control of power; propagation of violence, pornography and hatred.

3. Such debates serve to highlight the social complexity of technology as well as its pervasiveness throughout society and are of fundamental concern to the intellectual mission of UNESCO. This report will attempt to cover both the promises and the risks of ICTs, with an emphasis on their potential to support socio-economic and cultural development.

4. One of the driving forces for the growth of ICTs is convergence among the informatics, telecommunication and mass media technologies coupled with the convergence of economic interests of telecommunication operators, broadcasters, equipment and software producers, content industries and users of ICTs. The importance of these factors for access to telematics in developing countries was examined in detail, and corresponding strategy proposals formulated, in a recent joint study of the International Telecommunication Union and UNESCO (ITU and UNESCO, 1995) which served as a starting point for the present report.

5. It is clear, however, that the new applications of ICTs evoke a whole range of other phenomena with vast societal, cultural and ethical implications. Although the content of the information products transiting the nascent information highways is often seen as an extension of the traditional mass media, these highways also offer the flexibility and individuality of access characteristic of point-to-point telecommunication. Thus, when discussing the critical questions such as accountability, privacy, integrity of content and right of access, one cannot indiscriminately carry over solutions from the worlds of traditional publishing and broadcasting where these questions have arisen in the past. The report will draw on models from the latter worlds, but especially will stress the importance of a shift towards enhanced possibilities for creating, sharing and accessing information which have vast potential to benefit society at large and the developing countries in particular.

II. TECHNOLOGY FOR DEVELOPMENT OR DEVELOPMENT FOR TECHNOLOGY?

6. As in the case of previous development thrusts towards an industrial and then towards a service society, the ICT revolution today is being overwhelmingly driven by countries of the North and, perhaps more than ever by multinational corporations, which are defining and negotiating the various parameters, priorities, rules and processes of the future information society. This is happening at three levels of decision: the Global Information Infrastructure (GII), the National Information Infrastructure (NII) and the Local Information Infrastructure (LII).

7. It is important to recognize that these developments also hold profound economic, socio-political and cultural promise for the development of peoples of the South. The countries of the South can no longer view ICTs as only a luxury for the rich to enjoy. This growing recognition has meant that many developing countries are now struggling to "catch-up" with the industrialized countries in terms of access to ICTs. The concerns of developing countries regarding their participation in the GII and NII now bear less on whether this should be accorded high priority, than on how to effectively apply information technologies to development so as to reduce, rather than widen and deepen, the gap between information "haves" and information "have-nots". Such a strategy, however, raises several issues.

8. Until very recently, the countries of the South and their interests have not been part of the international debate on ICTs. This situation has begun to change as the concerns of the South have been debated at a number of forums, including the G7 Conference on the Information Society (Brussels, February 1995). The May 1996 Information Society and Development Conference in Midrand, South Africa was the latest effort to effect a greater balance in this debate. However, these discussions have tended to focus on the each country's NII and how it can be linked up to the GII. The countries of the South have not yet been given a serious role in the larger discussions of setting goals and standards for the GII. Nor have they in general been actively considering options and strategies for flexible development of the LII. Such exclusion has strong implications for constraints to the free flow of information, quality and relevance of information, ethics, cultural diversity, equipment and network standards, and other important global issues.

9. The goals for developing countries and ICTs are often being framed essentially in terms of access to technology and access to information. It may, however, not always be true that the most critical problems confronting us at both personal and public levels require technical solutions through fast access to information otherwise unavailable. Neil Postman poses this question as follows: "In Technopoly, we are driven to fill our lives to 'access' information. For what purpose, or with what limitations, it is not for us to ask; and we are unaccustomed to asking, since the problem is unprecedented. The world has never before been confronted with information glut and has hardly had time to reflect on its consequences" (Postman 1992). History has shown that just blindly chasing after access to the latest technologies, without asking for what ends, will not allow us to achieve many of our goals for development. The

overriding questions as countries (industrialized and developing) must be: *What are our goals, how do these goals relate to creating a better world, and how do the technologies we pursue help achieve our goals?* It is crucial that these questions be continually raised at the local level, the national level and the global level by developing countries.

10. Such discussions have begun to take shape at the national level with the recognition that information must be appropriate to developmental needs. In May 1995, for example, the Conference of Ministers of the UN Economic Commission for Africa (ECA) directed that a high-level working group of African technical experts be created to deal with the role of information, communication and knowledge in shaping an African information society to accelerate socio-economic development. The report from the working group articulates an initiative for the formulation and development of a national information and communication infrastructure (NICI) plan in every African country. This initiative is based upon two themes intricately related to issues of impact and access: national development challenges such as debt management, food security, health, education, population, job creation, industrialization, land reclamation, water, tourism and trade; and, cooperation, linkage and partnership among African countries (UNECA 1996).

11. However, even in stating these national goals, developing countries must be careful not to conceive of ICTs as a sort of panacea. Simply layering these technologies on existing systems, bureaucracies and processes will not achieve countries' development objectives. Development sectors are all very complex and each has an underlying history. They face many problems starting with an inability to process existing levels of information. Institutional problems - like unmotivated and highly centralized bureaucracies which may be weakened by paralyzing hierarchies and corruption, massive economic disparity and various forms of social discrimination - may be even more important and cannot be simply addressed by increased access to information. This flag of caution is waved, not to discourage those pursuing technology but rather to stress the framework in which new ICT applications and services attempt to operate. There is, in addition, something quite unique and important about these technologies. They are agents of change, which are powerful enough to change the economic, social and cultural contexts in which they operate. They actually present societies and individuals with the opportunity to question fundamental assumptions and institutions, to re-think existing approaches and mechanisms, to collectively conceptualize and generate new ideas and community-based alternatives and even, sometimes, to catalyze social change. Converting these opportunities into social benefits requires that leaders not hide behind the technologies to avoid dealing with fundamental issues but rather be willing to make very difficult decisions regarding the application of ICTs in their contexts.

12. Global and national goals should not mask the diversity of users and their specific needs within a country, ranging from individuals to different social, professional and geographic settings to non-governmental, governmental and international organizations. The needs of these diverse users will vary enormously, and thus, in addition to developing the Global Information Infrastructure and the National Information Infrastructure, it will be critical to develop the Local Information Infrastructure (LII). ICTs provide a unique opportunity to move beyond centralized models of planning, management and governance. In this context, access to technology and information for the South is important but the content carried is at least as, if not more, important. For example, an individual farmer may have needs for very

specific, locally oriented information concerning crops, transportation and health. Access to the riches of the Library of Congress may be of no interest at all. The reverse is likely true for researchers working on a university campus. Therefore, efforts must be made to enable people in developing countries to produce endogenous information and knowledge and to filter and evaluate the information they need, rather than simply being passive consumers of imported information. Passing to such an active creative role is also an essential step towards full participation in the Global Information Society with its possibilities for each nation to disseminate and, where appropriate, profit commercially form, its intellectual competence and cultural heritage.

13. Related to the LII is the question of which technologies countries should invest in. Investment for access to ICTs has many dimensions. For example, even if telecommunication costs were reduced to zero, the number of people in the developing world accessing electronic information might not greatly increase. Other factors, such as the cost of a computer system or modem, the lack of electricity, physical disability, illiteracy, social inequities or simply lack of interest can be equally constraining. And while it is true, in a macro sense, that the cost of informatics is declining, the implications of this decrease need to be carefully considered within the relative purchasing power of the local user. For example, what little disposable income that might be available to an individual in the developing world is more likely to be spent on a US$ 15 transistor radio than on a far more expensive computer system or satellite dish.

14. Local conditions within a country may vary enormously which implies that different approaches should be supported. The Internet - and its counterpart for closed user groups, often referred to as Intra-net - has emerged as a surrogate for future information networks, yet it is by no means the only source of electronic information. Leaders may miss important opportunities by placing too much emphasis on the Internet and not looking at exciting innovations in some existing technologies, such as radio, television, CD-ROM and cassettes. Such "older" technologies may be more appropriate means to satisfy many information needs in developing countries, particularly as components of larger systems integrating different levels of technology.

15. While the immediate returns of investment in information and communication technologies may not be readily apparent to hard-pressed administrations concerned with squeezing the most out of limited resources, the long-term positive impacts of a proactive strategy may be considerable. However, within this context, developing countries still must make difficult decisions about which sectors to invest in, and what types of ICT programmes within those sectors to support. Providing access to ICTs for certain sectors of society, particularly illiterate and rural populations, is a particularly important but costly and difficult challenge. Decision makers must continually negotiate a balance between short-term demands and long term goals. Within a broader national perspective of co-ordinating efforts and reducing costs, they should also seek to maximize partnerships and opportunities for sharing.

16. Each ICT (and combination of ICTs) has particular strengths and weaknesses which may be more or less appropriate for a specific application. In particular, one should continually ask how ICTs can be transformed from simply serving as channels for transporting large volumes of information into more dynamic communications and learning tools.

17. All of the above means that each developing country should adopt investment strategies and programmes concerning ICTs which are appropriate to the national and local situations.

18. This report seeks to examine the question of how ICTs can be used by developing countries to achieve their development goals, particularly in the areas of education, science and culture, and also to consider how ICTs can be used to assist developing countries in continually rethinking and reformulating their broader goals in these sectors. It will thus consider applications, services and infrastructure from a generic and policy viewpoint and will not attempt to categorize and evaluate the role of specific ICTs (such as artificial intelligence, parallel processing or advanced data transmission protocols). Section III argues that high priorities should be accorded to ICTs in the core "intellectual" areas which drive the development of telematics and which are of particular concern to UNESCO - education, libraries, scientific research, environment, culture and mass media. This section discusses current and future applications and priorities of ICTs in developing countries as well as specific concerns and key issues in these areas. Section IV discusses barriers that currently stand in the way of realizing the potential of ICTs by developing countries and highlights some of the creative responses that are emerging. Section V, the final section of the report, concludes by highlighting key short-to-mid term public policy options in relation to the GII, NII and LII that should be considered by developing countries.

III. KEY PRIORITY AREAS AND FUTURE POSSIBILITIES

19. In this section, the need for developing countries to focus ICT applications on certain core "intellectual" areas of development - education, libraries, scientific research, environment, culture and mass media - is highlighted. These sectors of public concern have a critical role in the development process and have major needs for investment in ICTs, but are disadvantaged by dispersed resources and shrinking public sector budgets. They should be seen, moreover, as a potential test bed and driving force for progress towards an Information Society in developing countries, because they hold stores of knowledge and expertise necessary for this evolution and because of their natural role in informing, educating and mobilizing the public to face tomorrow's challenges. The applications and contributions of sectors of public concern in the area of telematics were considered in detail in a recent international study (ITU and UNESCO, 1995), which recommends a strategy to facilitate access to telematics facilities by these sectors involving i) consolidation of user demand, ii) cooperation with telecommunication operators and the commercial sector, and iii) appropriate public support in terms of investment and enabling environment.

20. Within each of these sectors, there are many choices that can be made regarding foci for application of different technologies. For example, within education, should one focus ICTs on higher education or primary education? In prioritizing these choices it is important to look not only at their direct benefit but also at their ability to create catalyzing spill-over effects in other areas of development. Identifying these priorities and understanding key concerns around them will be an important challenge for leaders in developing countries.

21. Inversely, there are many concerns which apply to the sectors of public concern as a whole, such as training of users and ICT specialists and providing access to information to the widest

possible public. These will be summarized in the final two sections of the report.

Education

22. The multiplicity of problems facing formal schools today are well known. On one level, they are discussed in terms of low numbers of qualified teachers and large numbers of students per class; inaccessibility and inflexibility of schools and universities; outdated and irrelevant curricula and methods of learning; and lack of quality educational materials. On another level, there is a tremendous gap between relationships between schools and communities, teachers and learners, and learners and learners as well as a lack of interest in the endeavor of learning, critically thinking and reflecting. There are few opportunities for second chances, and learning is conceived of as a discrete activity that one only attends during the early years of life. Very little provision exists for lifelong learning opportunities. Many learners are not reached by the system. Today, there are 900 million illiterates in the world and 130 million children unable to attend primary school. Their access to education is limited by time and space, age, socio-cultural environment, work schedules and physical or mental handicaps.

23. Distance education has been used in the formal setting to enhance teachers' performance and learning materials. More recently, it has been pursued as an approach for reaching populations who are not adequately served by the formal system. However, distance education has faced several constraints: lack of interactivity; long development cycles; lack of flexibility of materials; insufficient support mechanisms for learners. The result is that distance education is still often regarded as a "second class" option by many if not most learners.

Applications of ICTs in Developing Countries

24. The main application of ICTs in education has thus far been in the area of distance education, which has been the subject of many experiments using various modalities in the past two decades. Historically, the application of computer technologies to distance education has concerned primarily computer-assisted learning (CAL), mainly through the use of stand-alone systems. The results of CAL have been mixed, many CAL applications having failed in the past because they were improperly conceived of as ways of "replacing" the teacher.

25. The use of telecommunication and/or broadcasting technology, combined with informatics where appropriate, provides possibilities for increased spontaneity, interactivity and accessibility. Some of the most successful efforts in use of ICTs in developing countries have been with interactive radio instruction in the formal classroom (in this approach "interactive" truly describes the relationship of the learners to the teacher, even through only one-way physical communication is employed). One-way television has been used to broadcast courses into classrooms, but this medium is limited by lack of interactivity. Some experiments are being done with interactive television in developing countries (generally starting with one-way video, two-way audio), such as with in-service teacher training in India. Of the various modes of use of telecommunication channels, audioconference and slow-scan videoconference have been shown to be particularly useful, adding substantial value to communications links at relatively little cost. Major applications include tutorials and administrative support for educational networks. The SISDIKSAT and UWIDITE projects (Indonesia and the Caribbean respectively) show that these technologies are quite feasible and viable in developing country situations (UNESCO 1994).

26. Most of the major successes of ICTs in education thus far have been in specialized or higher education (including "open" universities, teacher training, and industrial applications) where students are more likely to be motivated, to possess special language skills and (at least in the industrialized countries) have prior computer experience. The growing involvement of open universities in developing countries (see Table 1) attests to this progress. One of the major weaknesses of these technologies has been in facilitating basic education which typically requires more supervision, more user-friendly, culturally sensitive interfaces, and presentation in the vernacular language. The increasing variety of interactive media (e.g. compact disks, interactive TV and the Internet) enlarges the scope and possibilities of self-directed learning and group learning.

Table 1: Distance Education Universities in Developing Countries

Institution	**Enrolment**
Central Radio and TV University, China	1,000,000
Korean Air and Correspondence University	300,000
Sukhothai Thammathirat OU, Thailand	200,000
Allama Iqbal Open University, Pakistan	150,000
University of South Africa	50,000
National Open University of Taiwan	48,000
Indira Gandhi National Open University, India	30,000
University Nacional Abierta, Venezuela	29,000

(Brown 1992 in Willis 1994)

Priorities for the Future

27. Several opportunities are opening for ICTs in education in transforming the learner/teacher relationship, the means of transmission of the educational message, the production and use of educational materials, and the organization and function of educational structures.

28. First and foremost, developing countries should accord priority to connecting schools and universities to national and international distance education facilities, databases, libraries, research laboratories and computing facilities. Interactive sharing of information and ideas is critical to the mission of education. This would involve promoting and supporting dialogue and collaboration among teachers and researchers; between learners and learners; between classrooms and communities.

29. Second, the use of ICTs in distance education should be actively pursued, particularly to provide on-going learning opportunities at the community level. In addition to being cost-effective based on new functionality, easier access and economies of scale, ICTs will be critical in building a culture of lifelong learning in both urban and rural areas. Through differentiation, specificity, and better learner and teacher control, ICTs can accommodate the individual needs

of most users. It will be critical to creatively explore how relatively expensive equipment can be made available to various needy user communities, i.e. through centres visited by students, mobile equipment such as computer bus classrooms, etc. In some cases improvements in existing technologies rather than entirely "new" technologies can best be used to meet the needs of learners. For example, the new compression and digital transmission technologies are giving new life to "traditional" educational television, by permitting many more channels to be broadcast over a given bandwidth at a much lower cost per channel, and, in the case of direct-broadcast satellite, over a wider geographic area. Efforts must be made to create multichannel learning environments, as single media projects have tended to fail in the past.

30. Finally, ICTs should also be used to reduce the communications and administrative costs of educational institutions. Many institutions suffer from managerial insufficiencies which could also be significantly improved by the application of ICTs. Such action, if implemented properly, should result in higher staff morale, greater understanding of the needs of students and an enhanced ability to provide appropriate support services.

31. It is very important that these efforts to make effective use of ICTs in education foresee the human element. Although educational technology may enable a reduction in the teacher-to-learner ratio or in qualifications of on-site teachers, it cannot (and in the foreseeable future should not) replace human decisions and interaction in the educational process; specialized teaching and support staff will still be needed, and in fact will have to take on new responsibilities and learn new skills to serve as intermediaries and motivators, oversee student testing, follow up on feedback, etc. As long as learning is a human endeavor, there will always be a need for human "teachers" in some capacity.

Key Issues And Challenges

32. Today, the ICTs afford the exciting opportunity to begin questioning some of the basic assumptions and the choices that were predicated on them and to re-open discussions around the nature of learning, the content of learning and the role of facilitators and places for learning. We must seek to use learning systems to encourage reflection, creativity, expression, cooperation, social responsibility, democratic values, and tolerance. Learning modes will become a diversified mixture of self-instruction, group work and tutoring. This process will be complicated and difficult, particularly as there are many different audiences of learners to be targeted - students, skilled workers, general public, pre-school, primary level, secondary, tertiary, etc.

33. The solution lies essentially in the organizational, pedagogical and cultural realms, but ICTs can have a key enhancing role if applied correctly. The new concepts of on-line connectivity, virtual environments and groupware methodologies can contribute to building a tradition of life-long learning. The trend is now towards multimedia systems combining text, data, sound, all types of image (single frame, video, 3-D) and even touch and other senses (virtual reality). Although multimedia have mainly been successfully applied to entertainment and to very specialized training (e.g. flight simulators), their potential for contribution to "mainstream" education is enormous provided that new paradigms evolve for conceiving, developing and financing such applications. The shared presence of "virtual communities" holds particular promise for educational applications, but unexplored issues need to be addressed by educators, information scientists, psychologists and even philosophers, as well as

technical questions as to how the associated new ICTs can be applied in the limitations of developing country situations.

34. The commercialization of education represents a critical challenge. Trend analysts widely agree that "edutainment" and distance learning are among the information products and services which will develop the most rapidly in the next few years. But the home education software market is now considerably bigger than the courseware market for schools [1], due in large part to the higher development costs in the latter market and the problem of teacher training (McKinsey & Company 1996). This may continue to skew the industry towards "edutainment" products. It is important that the market not be oriented only by industry; educators should become involved in the courseware planning and development process so as to benefit fully from the new opportunities. Efforts will also have to be made so that the less profitable areas of education are not ignored. The market must not overshadow the need for sound instructional principles and clarity of learning goals.

35. Perhaps the major emerging challenge is that of content and of creation of a stock of programmes which can be used locally, nationally and internationally. But, apart from a few privileged sectors such as language teaching, informatics training, and practical know-how (which often remain at the margin of formal education systems), attempts at transnational use have come up against many difficulties (language differences; disparate pedagogical methods, diplomas and curricula; legal problems concerning the copying and use of audiovisual materials).

36. To meet these challenges, the education sector must organize itself as a major technology customer, partner in service development, and creator of new applications. Collaboration among various actors will be needed to take full advantage of ICTs in education. In addition to the public authorities whose role is essential, there are publishers, manufacturers and broadcasting companies, telecommunication and satellite operators, universities, large distance education organizations, libraries and documentation centres, and research institutions. In this context, regional and international cooperation in development and delivery of educational products and services may be one way to reduce costs and share resources (UNESCO, Second International Congress on Education and Informatics, 1996).

37. It is important to understand that the economic problems of distance education technology are not limited to the costs of initial system development and installation. Other major expenses, including those of maintenance, training, quality control and continuing development, are also critical. All of this implies careful planning. It is only after a system is well established that one can normally expect to benefit from economies of scale, either through lower cost of education or in terms of contributions to development.

[1] This was estimated in 1996 to be US$ 1.4 billion for the home education software market versus US$ 290 million for the school courseware market.

Libraries

38. With strong budgetary cutbacks in the public sector as a result of harsh structural adjustment programmes, libraries in many developing countries have seriously deteriorated in recent years. In some of these countries, reasonably good networks of public libraries did exist but these were usually based on the European model of serving leisure readers in major towns and cities. In others, the concept of public libraries was never very popular, and libraries were restricted to elite universities and inaccessible to the general public. In either case, today libraries of all types face substantial problems in many developing countries. Some of these problems stem from a lack of funds, while others are linked to deeper socio-cultural concerns.

39. Very few libraries exist in developing countries, particularly on a *per capita* basis, and those that do exist have extremely limited accessibility. They are extremely weak in meeting the needs of disadvantaged and rural communities. Part of this is also due to their limited hours and their immobile nature. The user must come to the library rather than the library going to the user.[2] Another problem is that they are sometimes viewed as foreign institutions. Many have not really been culturally accepted by communities and as a result are not really considered public centres.

40. From the viewpoint of infrastructure, libraries in developing countries tend to have very limited access to international journals, recent books and periodicals, audio-visual materials, etc. The materials that do exist tend to be focused on issues and needs of industrialized countries and lack relevance to the context and needs of local users. In addition, libraries are confronted with limited space to store information and often lack the proper equipment and facilities to provide useful services to users. Libraries also suffer from insufficient numbers of staff, and existing employees often have very low levels of training. To compound problems, libraries are usually viewed as stand-alone entities and are not well-linked to other institutions. They lack efficient and affordable data communication services required to provide speedy access to local, regional and international information sources.

Applications of ICTs in Developing Countries

41. Significant efforts are already being made to use ICTs to provide more information to libraries and to facilitate resource sharing among them. For example, many university libraries in Africa have recently been equipped with CD-ROM drives and have begun to make extensive use of this medium. Initial efforts are being undertaken to network libraries to the Internet, as access in and between countries in different geographic and development situations is becoming recognized as increasingly important. However, these advances have for the most part been concentrated in university-based libraries with school, public and specialized libraries being largely excluded.

Priority Areas for the Future

42. Developing and industrialized countries should work together towards the gradual development of a "global digital library" reaching down to the community level, building on

[2] Some of the most successful libraries have been those in which the collections were mobile. For example, in India, reading materials have been picked up and delivered on a weekly basis to remote villages by workers on bicycles.

nascent international efforts like the Global Information Alliance led by the International Federation for Documentation (FID), the proposed "Global Digital Library Initiative" being considered by the International Federation of Library Associations and Institutions (IFLA) and the G7 pilot project entitled Biblioteca Universalis. Libraries must seek to become computerized and interconnected so as to pool their resources and provide to their clients access to immense stores of information. Specific efforts should be made to provide practical information sources, particularly at the community level, and to close the resource gap by making textbooks and periodicals electronically available, especially for schools, universities and research centres.

43. Priority should be given to providing mechanisms for the exchange of information among existing libraries in ministries, municipalities, universities and schools. Developing countries may also wish to seek to automate their national libraries and make them accessible on-line. ICTs, particularly telematics applications capable of good performance over marginal communication channels, will be important in enhancing services for information retrieval, library loan requests and electronic document delivery. Archiving functions should also be developed and adapted to assist with replacing paper documents. Libraries and information centres must also seek to develop more user-friendly services, and to extend their holdings and services in the area of audiovisual and computer-based courseware. Library staff will require additional training as well, to adapt to new institutional settings and employment opportunities.

44. ICTs may offer a genuine opportunity to place libraries at the service of community development. Libraries are ideally placed to serve as public gateways to information highways, providing as they do both access and guidance and training to users. Libraries and information centres may be one of the most cost-effective means for providing more people with access to a range of ICT-based services. Furthermore, libraries will be needed to play a critical role in mediating ICTs and helping the public to overcome a learning threshold in accessing information (UNESCO and an Information Society for All, 1996).

45. One interesting option in promoting and building on the role of libraries would be for developing countries to consider supporting community telecentres offering library, information and media access, social services like education and telemedicine and forums for participatory democracy, as well as personal communication facilities, based on the cooperative organization of these services and on enabling "last-mile" communication technologies.

Key Issues and Challenges

46. The demands on libraries and on organizations that support libraries are expected to increase in the coming years. They must become increasingly involved in electronic information provision as their clientele in government, research and the general public develops ever more sophisticated needs. For example, the demand for electronic interlibrary loan services is expected to increase as the international standard protocol for this application (ISO 10161) is implemented on a wide scale. The demand for electronic information retrieval is also expanding rapidly (ITU and UNESCO, 1995). Libraries will have to meet these challenges or find themselves rapidly antiquated. Obviously, one of the main issues facing libraries in this context will be that of securing funds which will be needed to invest in equipment and networking costs.

47. However, it should be clear that digitalizing libraries for timely and comprehensive access to information does not necessarily mean replacing books. The increasing popularity of networks will not decrease demand for books, and in fact has caused a dramatic increase in use of paper for print-outs and copying. Computer screens are less easy to read than hard copy and cause documented physiological difficulties; continued R & D will be needed to encourage the development of appropriate paperless applications.

48. A real issue that stands in the way of universal access to knowledge is acceptance of libraries by communities as centres of community interaction. ICTs can facilitate or obstruct this process depending on the way they are introduced and used and on the support and involvement of the communities concerned.

49. Success in meeting these challenges will depend to a large degree on ability to train and retrain a large pool of information specialists who are versed in the development and management of ICT based services. The creation of needed educational programmes and institutions for this purpose constitutes a major challenge in itself, which will in turn require the effective application ICTs in the educational process as discussed above.

Culture

50. The realm of culture encompasses many different areas. Several problems have existed in trying to preserve cultural heritage such as monuments, manuscripts, artifacts and music. These again stem, in part, from deteriorating resources. Another critical issue is the lack of regional or local access to cultural sites and forms of expression within developing countries and internationally. There is often more information available on a local culture outside of the country than inside. In addition, many forms of cultural expression still remain elitist, in the sense that very few people have access to them. There is also a lack of cultural information available on marginalized populations (for example, many tribes in Africa or India) and on the contributions of certain groups (such as women) within those cultures.

51. The other major issue related to culture that is emerging and is the subject of heated debate concerns the role of ICTs, particularly in cultural globalization and homogenization of popular culture. The expansion and concentration of television, radio and film production in a relatively small number of countries and enterprises tends to favor conformity and standardization at the expense of specificity, adding to the concern about the loss of native culture. There is fear that many essential elements including language, folklore, oral histories, traditions, and foods may be lost in the process. Many leaders are concerned by the lack of cultural diversity and the dominance of North American culture. However, although film and television programming from the United States of America flood the world's airways, such material also comes from other sources. For example, a recent survey of programmes produced in India revealed that more than 70 percent of these were considered violent by the people surveyed. In another survey of nine Asian countries, all with a fairly high level of local programming, at least 60 percent were perceived to be violent. A linked apprehension is the raising of unrealizable expectations among people who are widely exposed to the lifestyles and languages of the affluent, while the pace of material progress in their own environment is painfully slow (de Cuellar, 1995).

52. Although some of these same concerns apply to the Internet and other internationally accessible communication networks, information highways also provide a new model by giving any individual or community with access to a microcomputer and a telephone line vast possibilities to share in the world's diverse cultures and to create and disseminate cultural works.

Applications of ICTs in Developing Countries

53. Multimedia technologies such as CD-ROM already offer tremendous possibilities for the promotion and sharing of physical and non-physical cultural heritage, as well as opening up vast new horizons for experimental art. Such applications are expanding the capability of museums and galleries to allow clients in even the most remote parts of the world to have visual access to the world's most valued treasures. On the whole, these technologies have an immense potential for enhancing cultural identities, promoting intercultural dialogue and stimulating artistic creativity.

54. Building on a growing stock of electronic cultural products, organizations responsible for access to cultural and heritage materials have wide-ranging potential uses for telematics. For example, those concerned with works of art use data communications, throughout the world, to access catalogues and databases which may offer sophisticated image retrieval (including the possibilities of 3D representation). Communication among cultural institutions is receiving initial emphasis, with an increasing number of telematics applications open to specialized researchers and, more and more frequently through the Internet and particularly the World Wide Web, to the public at large.

55. Although some developing countries, such as Egypt, have made substantial progress in this area, others lag behind in the recognition that the digital representation of their national music, art, folklore and monuments provides the essential raw material for their participation and visibility in the evolving Information Society, with its inseparable economic and cultural ramifications.

Priority Areas for the Future

56. Developing countries should focus on the use of ICTs for both cultural preservation and development. Governments should enhance capabilities of cultural organizations to engage in electronic preservation and documentation of manuscripts and artifacts. They should also seek to increase the accessibility of museums, rare manuscripts and artifacts to researchers and the general public through the development of cultural ICT products. There should be a strong priority on establishing electronic communication and innovative telematics applications involving cultural sites, repositories of culture such as libraries and museums, and centres of research and learning. Maximum impact can achieved through the establishment of effective and interconnected specialized networks which build on and encourage synergy among institutions with complementary programmes and cultural and historical affinities.

57. In addition, developing countries must make strong efforts to support the development of indigenous content by the diverse communities that comprise a country or region with a view to building greater pluralism and tolerance. Production of content by local creators will be critical to promoting cultural and linguistic diversity and to the development of national

cultural industries. Appropriate ICT infrastructures and applications can make important contributions in these areas.

Key Issues and Challenges

58. Technology offers substantial possibilities to facilitate the development of local content and specialized services to cater for diverse cultural needs. These advantages are, however, counterbalanced by a danger that groups of media users may prefer cultural specificity to diversity and dialogue, and thus run the risk of shutting themselves into a cultural ghetto. At the same time, it must be kept in mind that many small or even medium-sized countries do not have the critical mass, in either economic or demographic terms, to guarantee adequate local and national content and may thus largely depend on imported programmes and services.

59. In addition, efforts will have to be made to protect the rights of local creators while at the same time ensuring the availability of low cost cultural services for individuals and society. There is considerable concern about ensuring protection for parts of works made available in digital form. A transmission right is widely seen as necessary to protect the access of digitalized works over electronic networks. Both individual and collective rights management will be important in this context, depending not only on the preferences of the parties concerned, but also on the increasingly diverse nature of the distribution channels (UNESCO, Symposium on Copyright and Communication, 1996).

60. Another challenge lies with the commercial forces unleashed by ICTs. Despite adaptations to local markets, the increasing sophistication and concentration of communication technologies can encourage the standardization of content. When audience ratings are paramount, creative possibilities may be severely restricted. New electronic networks must seek to transmit the widest possible variety of cultural viewpoints together with information which may not be commercially profitable or may interest only minority groups.

The mass media

61. There is a growing awareness that pluralism of information, together with a diversity of production and distribution, are prerequisites for as well as indicators of a properly functioning democracy. A strong national and local system of mass media - journalists, radio and TV, newspapers and news services, etc. - is essential to this mission. However, most developing countries lack a strong tradition of diversified mass media. In most developing countries today, there is a dearth of access to diverse channels of information which serves to limit citizens' ability establish informed opinions and therefore participate in public affairs. Community media are particularly constrained in many countries.

62. In addition, the mass media that do exist in developing countries today are hampered in carrying out their roles of informing society and stimulating thinking about issues. Often, the problems of limited media sources are exacerbated by biases (e.g. political control) of the media. Information tends to be highly concentrated in urban centres and to have a national rather than a community focus, due in part to insufficient awareness of and access to ICTs at the local level. News agencies are confronted with high costs for telecommunications combined with obsolete technologies and software, which have serious implications not only for the quality of information that is being reported and but also for the very survival of the

agencies. This situation also serves to restrict access to and maintain tighter control over mass media.

Applications of ICTs in Developing Countries

63. Several developing countries have already adopted major technological innovations such as electronic editing and generation of images in TV programme production, as well as computerized and communication-assisted publishing of the printed press. The evolution of computer technology over the past fifty years has led the press in many developing countries to progressively automate production chains, from the submission and editing of articles, through the transmission and management of photographs, to the formatting and printing of the final product; this has in turn resulted in increased use of ICT equipment and telecommunication services (Hopkinson 1996). Newspapers and press agencies use telecommunications to disseminate current news bulletins and compile news databases which are often made available to the public through database hosts. It should be remembered that press bulletins still provide most of the substantive content of written or spoken media, and their acquisition thus represents a major expense for these media. Press organizations are traditionally heavy users of leased telex (teletype) and voice grade lines for data transfer, but are making ever greater use of computer data networks, including the Internet.

64. Independent broadcasting services provide a venue for people's immediate interests. Direct and indirect public aid for programme production still need to be strengthened, however, so that the local context can be reflected. This is where community radio and television come into the picture. Subject to availability of a modicum of funding, political commitment and infrastructure, community media are developing to complement public and commercial broadcasting. For example, peasants and miners in Bolivia have set up their own radio stations, broadcasting in Quechua, Aymara, or Tupi-Guarani. In Australia, Aborigines and Torres Strai Islanders have pressed, on the basis of their own successful experience in community broadcasting, for the establishment of an Indigenous Broadcasting Corporation funded by the government (de Cuellar, 1995). Independent radio stations in developing countries are beginning to make use of the Internet for exchange of information and to ensure dissemination of programming to the world at large, including when faced with local restrictions on broadcasting.

65. Portable video transmission terminals are being used more and more by major television organizations for news gathering from remote sites. This technology is currently unfortunately out of reach for most organizations in developing countries. At present, digital radio and television technology is still mainly limited to broadcasting studios, but some programme acquisition and exchange applications are already operational. Digital direct broadcast satellites will soon be widely available.

66. For the purpose of programme and news exchange, broadcasters have associated within regional unions such as the Arab States Broadcasting Union (ASBU), the Asia-Pacific Broadcasting Union (ABU), the Caribbean Broadcasting Union (CBU), the European Broadcasting Union (EBU), the Union of National Radio and Television Organizations of Africa (URTNA), which arrange for inter-member transmissions. For example, the Unions lease national and international circuits for daily news exchange among their members, including reserve circuits as necessary. International assistance has been instrumental in

creating the operational networks of the unions of developing regions (AFROVISION, ARABVISION, ASIAVISION, CARIBVISION) which concentrate on news exchange. Innovative uses of ICTs, particularly low-cost multi-point satellite channels, have greatly improved the reach and sustainability of these activities in recent years (ITU and UNESCO, 1995).

Priority Areas for the Future

67. Interactive television and multimedia open up yet unexplored perspectives for the mass media, for education and information as well as for entertainment, and provide opportunities to enhance the role of public service broadcasting. Efforts should be made to ensure that the rapidly developing media technologies are made available over a truly universal network, providing the public in both developing and industrialized countries with the widest possible access. Although broadband services should be developed where economically feasible, and can be expected to become increasingly available in developing countries through enhancements of telecommunication and cable TV systems, the media should also make use of existing possibilities such as the Internet to provide viable, interactive products and services which can reach a wider audience.

68. Priority should be given to developing localized sources of information. For example, the Asia and Pacific Regional Seminar on Information Technology for Newspaper Publishing held in 1995, provided recommendations on how small and medium-sized newspapers in the region can better apply communication, information and informatics technologies taking full account of social and cultural factors such as the need to adapt technologies to the national or local languages. In some countries, enabling technologies can only have the desired impact if accompanied by reform of the legal framework for the media, as expressed for example in regulatory and censorship policies (RCIS 1995).

Key Issues and Challenges

69. Several key issues merit attention. Although it is highly desirable to increase the diversity and number of media sources in developing countries, a number of considerations, primarily around cost, make it difficult to do so. The transition in progress towards democratic press structures presents a critical financing problem for newspapers and news agencies which are being forced to cut costs and develop new products to remain competitive. New and more effective use of ICTs should be considered by these media as a major challenge and opportunity in responding to the new environment.

70. As a result of deregulation and privatization of telecommunications, most of the major international news agencies (Reuters, AFP, UP, etc.) now transmit their services by satellite, which obliges their clients to acquire earth stations. The international agencies provide the stations and encode the information, giving them total control of the information transfer process. Technically, these transmissions are more reliable and efficient than the traditional radio transmission method, but many small agencies in developing countries find the new technology constraining and exorbitantly expensive, which represents a threat to free access to information.

71. Broadcasting unions could especially benefit from tariffs based on incremental costs, to make use of the significant spare capacity of the present satellite systems. Flexible conditions

for part-time or irregular leasing of channels, and long-term lease under fixed conditions with appropriate discounts, are needed. The lack of standardization of earth stations among international and domestic satellite systems is also a significant barrier to use of these systems (ITU and UNESCO, 1995).

72. The technological changes that have occurred in recent years should encourage the development of cooperation between telecommunication operators and the media with the aim of establishing new partnerships which would fully meet their needs and interests of both parties at the technical and commercial levels.

73. In addition, efforts should be made to encourage greater responsibility among the mass media for which maintaining integrity and sensitivity of information will be a critical issue. The FEMMED-WOMMED (Femmes et Media - Women and Media) network, for example, was formed under UNESCO auspices in 1995 to facilitate balanced access to expression and decision making in the media irrespective of gender (UNESCO, FEMMED-WOMMED, 1996). This network is both considering the Internet as a major new medium which is underused by women, and developing its action making full use of the potential of electronic information exchange.

Scientific research

74. The field of scientific research is shrinking in many developing countries. Budgets are becoming tighter. As a result, scientists in developing countries lack proper facilities and equipment for conducting research. Developing country researchers and scientists also lack access to scientific research conducted in developing countries and in industrialized countries. Their work is under-represented in much of the documentation and databases that currently exist. They are also constrained in sharing and disseminating information with different institutions within their country as well as with other countries. The result is that researchers and scientists in developing countries are not able to collaborate on an equal footing with their peers around the world.

Applications of ICTs in Developing Countries

75. Research and development depends by its very nature on effective access to and sharing of data and information. Certain privileged research institutions have traditionally been well placed in terms of budgets and technological expertise to take full advantage of new telematics techniques. The worldwide development of "research networks" - dedicated computer networks to provide basic telematics services to the academic and research sectors (electronic mail, electronic conferencing, file transfer and access to databases) as well as specialized computer resource sharing applications like supercomputer access and distributed processing, was the driving force for launching the Internet in industrialized countries and is now assuming this role in many if not most developing countries. Efforts in the developing countries thus far have concentrated on building basic network connectivity among researchers and to the Internet. This has been particularly useful for many smaller institutions which were kept on the margin of scientific field. In Latin America, for example, the development of research networks has been notable, facilitated by enabling government and operator policies, and, in Central America particularly, by cooperation among the telecommunication operators in promoting intra-regional data communications (Comisión Técnica Regional de Telecomunicaciones -

COMTELCA) (ITU and UNESCO, 1995).

76. Although many researchers still are unable to fully access the Internet, store-and-forward networks, based on UUCP or simple and robust PC-based technologies like FidoNet, now enable most major research institutions to interconnect for basic e-mail and file transfer services. The work of bilateral assistance programmes and of international non-governmental and intergovernmental organizations has been very effective in promoting international connectivity. Although much remains to be done in this area, the major problems for the research sector in most developing countries are now concerned more with upgrading and with improved exploitation of facilities rather than with basic connectivity.

Priority Areas for the Future

77. Developing countries should seek to support virtual scientific laboratories, in which researchers from developing and industrialized countries can collaborate through telecommunications and telematics on common projects. "Virtual" research groups will become increasingly common - composed of interconnected specialists working on the same problem in different parts of the world. Connecting these groups within developing countries and to related groups around the world will be a critical task. To this end, it will be important to provide network access not only to national scientific institutions but also to local-level institutions and to individuals in developing countries. Software should be developed to support effective group work (e.g. whiteboard, 3D viewing when needed) under the communication conditions available in the developing countries.

78. This connectivity will provide for access to information relevant to developing countries but stored in databases in the North. In addition, electronic publishing should be supported as it will provide faster and cheaper access to the scientific literature, and facilitate the maintenance of an international archive of scientific accomplishments.

79. All of these facilities should help in a large measure to improve the poor working conditions of researchers in developing countries, which are one of the principal causes of the "brain drain" phenomenon.

Key Issues and Challenges

80. Major issues facing the development of electronic journals are those of access to and quality control of information. At recent discussions on these issues, scientists have begun to opt for approaches favoring self regulation. For example, *The Experts Conference on Electronic Publishing in Science* (ICSU Press and UNESCO, 1996) recommended that strict peer review should be applied to all scientific material submitted for publication in electronic journals. It went on to suggest that a forum should be organized involving scientific societies in order to formulate codes of ethics and of conduct for electronic publication which would spell out the reciprocal obligations of the scientist and the community on such matters as peer review, citation integrity and authentication of material and archiving. Virtual laboratories, electronic libraries and virtual research groups must also face the issue of intellectual property rights such as patents and copyright which present particular problems in electronic media. It is clear that the concept of "fair use" must be extended to apply to use of electronic works in research and education while still protecting the rights of creators and producers of such works.

81. Another important issue facing the scientific research community will be how to electronically document the volumes of information that have been produced in the past and are currently being produced. The malleable nature of digitalized information requires the establishment of verifiable and accessible electronic archives. It will be important to establish principles and protocols for maintenance, content, structure, eligibility, accessibility and compatibility.

82. A major hurdle issue will be the costs of acquiring and setting up the ICTs. Telecommunication costs are still quite high in developing countries. Adequate and reasonably priced network access is essential for scientific work and scientific education. Network applications for virtual research, such as groupware and televirtuality, should be developed so as to operate effectively in the networking environments of scientific institutions in developing countries. International assistance should focus in this context on how developing countries can set up and optimize computer networks and applications for scientific research.

83. In addition, all scientists should receive training in information resources and library use and in good authoring skills, adapted to the electronic environment, if possible as early as the undergraduate level.

Environment

84. Environmental degradation, civil strife, earthquakes, floods and other natural disasters often cause chaos in unprepared developing countries. Insufficient emergency communication systems, especially on the local and village levels, limit the effectiveness of responses by state and international assistance organizations. Many of the areas threatened by environmental degradation and natural disasters are unable to adequately communicate with assistance organizations, and lack the terminal technology and applications to benefit effectively from existing communications. Concerned organizations still find themselves locked into reactive situations rather than being able to establish monitoring and information systems using geographic information system (GIS), remote sensing and satellite early-warning technologies which provide tools to anticipate and proactively respond to such problems. In addition, when important information is available there are often delays in getting it to people in time to help them. For example, drought and famine warnings may not arrive in time to change planting times.

<u>Applications of ICTs in Developing Countries</u>

85. Three categories of application can be cited: i) environmental monitoring and management, ii) emergency action and iii) sensitization of the public. ICTs are helping to expand humanity's capacities to understand and manage physical and ecological processes, and to forecast and respond to natural disasters. The Global Observing Systems for environmental monitoring, being set up through a UN system-wide initiative, are possible only because of advances in data sensing, processing, communication and presentation. The function of ICT applications to limit mortality, injury and loss of property will be facilitated by seamless links with the communication media available in the home and workplace (UNESCO, Telecommunications for Protection of the Environment, 1996).

86. One of the major priorities of UNESCO's Man and the Biosphere initiative today is the development and full use of the existing network of sites identified as biosphere reserves, of which 328 existed in 82 countries as of June 1995. Electronic communication and information technologies are indispensable if such a world network is to be effective. A recent example involves the introduction of Internet communication for biosphere reserves in the Central European region, where five countries (Belarus, Czech Republic, Poland, Slovak Republic and Ukraine) are co-operating with the GEF Biodiversity Protection Programme (World Bank) and other organizations to develop electronic networking capacity in some 31 protected areas, including nine biosphere reserves.

87. In the area of emergency action, efforts are being made to provide assistance organizations with detailed information on the sites where they must intervene using mobile workstations with all necessary data on the buildings, the terrain, and other site parameters, and complementing these with real time access to data on rapidly changing factors such as meteorological conditions and mobilization instructions.

88. Efforts are also being made to sensitize the public to different environmental issues. ICTs are allowing much more information to be made available to the general public much more quickly than before. An example is the International Tsunami Warning System (ITSU), established under the auspices of the Intergovernmental Oceanographic Commission (IOC). ITSU disseminates Tsunami Watches, Warnings, and Advisory Bulletins. Dissemination agencies also have a continuing responsibility for educating the public concerning the dangers of tsunamis and for developing safety measures that must be taken to avoid loss of life and to reduce property damage.

Priority Areas for the Future

89. Several goals must be addressed by developing countries. They should seek to implement networks which, as far as possible, provide access to telecommunication in areas threatened by environmental degradation and natural disasters. This might involve facilitating the use of low cost terrestrial and satellite radio communication systems in emergency situations. In addition, they should attempt to establish problem monitoring information systems using geographic information system (GIS) technologies, remote sensing and satellite early-warning. They must seek to devise means of getting information to people. Two kinds of architecture should be foreseen:

- passive distribution for products requested by users to assist in decision making concerning avoidance or response to natural disasters. The user will plug into a comprehensive and cost-effective network of servers like today's WWW. Radio, hard copies and fax transmission will decrease;
- active distribution for information related to natural hazard or warning systems. The emergency service will have to automatically trigger the process of information distribution to the end user.

Key Issues and Challenges

90. Remote sensing and GIS can be valuable tools for resource managers and policy-makers concerned with environment and development problems. But, despite technological advances and diminishing costs, the potential offered by these technologies has not been fully assessed or realized. Further research is needed to assess the costs and benefits of using the technologies

for various types of applications. In addition, a number of constraints to the use of the technologies - mostly of an institutional nature - need to be addressed. They relate to access to and exchange of data and information, to training and to costs. An important goal is the unification of information standards and terminology which would facilitate the compatibility of environmental information systems.

91. Environmental data are also an important economic commodity. Most of the information is concentrated in industrialized countries due to their possession of remote sensing facilities, where it is sometimes viewed as a national resource to help predict and influence the development of markets such as that of agricultural products. One troubling tendency is for the concerned agencies and enterprises to encrypt remote sensing data, accompanied by substantial increases in the cost and complexity of use. The international community should find ways to ensure that a balance is achieved between commercial interests and the need of developing countries to gain access to data concerning them, whether this be for disaster mitigation or for open and co-operative scientific research.

92. Another challenge is that since the nature of environmental information is very complex, much remains to be done to popularize it and get it to the general public. For example, after the Chernobyl disaster, information did not reach the population concerned in time from political leaders, which led to contamination of thousands of victims who could otherwise have been protected. Hence the ethical task of experts to duly inform and sensitize the decision makers and to urge them to provide means and facilities necessary to "sensitize" the people and draw their attention to environmental problems.

93. In case of emergency, the Internet is not the most appropriate warning system. For natural catastrophes like an earthquake or a flood, means of communicating information have to be found which are independent of standard terrestrial communications (e.g. VSAT, mobile telephone). A substantial improvement in warning could be achieved by the wide use of radio receivers that would be activated automatically after receiving a special signal. This would allow the dissemination of detailed instructions to the population regarding the action to be taken, rather than relying on sirens or other "information-poor" systems to which the general public rarely knows exactly how to react. Appropriate measures should be developed to ensure that, in case of emergency, the bandwidth necessary for the transmission of the required information, including images, is available on the Internet or other designated networks, avoiding any delay caused by overload by the great number of users not directly involved in crisis management.

IV. CONSTRAINTS TO REALISING THE POTENTIAL OF ICTs IN DEVELOPING COUNTRIES

94. The challenge that stands before developing countries is how to ensure that all segments of society get appropriate access to the benefits that ICTs offer. Before discussing the constraints which are at the root of this challenge, it may be useful to consider the overall goals to be met. First, there is the issue of "benefits", that is, how to ensure that the benefits are consistent with individual, local, national, regional, global development priorities and do not contradict or undermine indigenous development goals. The idea of benefits must be continually reviewed

and re-evaluated in this context. Then, there is the question of which benefits should be freely available to all human beings and which should be paid for. There is also a deeper issue of access which is concerned with not only making sure that individuals and user communities are able to reach the technology and information that is currently available but also to ensure that they are involved in framing and generating new content and applications. It thus becomes critical not only to protect the interests of diverse (and particularly, smaller) creators, producers and distributors but also to actively support their involvement at the local, national and global levels. As has been discussed, cooperation and sharing of relevant content will be extremely important, particularly at the regional level.

95. A second caveat is the need for clarity on what "all segments of society" means. There are many potential end-users of ICTs within any developing country context including individuals, universities and educational institutions, NGOs and community organizations, businesses, government, public institutions and donors. Each of these users has different sets of needs in terms of content, technology applications, equipment and data speed transfer, levels of connectivity and interactivity, etc. They represent different age groups and cultural perceptions, with different affinities for and familiarity with ICTs. They also have different infrastructure constraints, e.g. related to urban, semi-urban, rural and remote environments, as well as limited budgets for purchasing equipment and software. The case of India, for example, illustrates the stark divergences that can occur within a country when one compares, for example, Bangalore to the tribal areas of Assam. Providing individual access to each of these end-users, a model being developed in some countries of the North, is still not a feasible one for most developing countries despite declining equipment and telecommunications costs. It is essential to develop shared public spaces for people to jointly access different technologies and information. In addition, there must be an acceptance that not all end-users will need to have access to the most sophisticated forms of technologies, when many goals today can be met through well-established "traditional" technologies. Phased approaches concerning the introduction of technologies should thus be considered. Finally, it is extremely important that emphasis be placed not only on making sure the end-users are connected to the GII but also that they are connected to each other within the nation and local communities.

96. This section will outline some of the constraints to access and provide examples from different national situations as to how these are being addressed. It is important to emphasize that barriers concern not only issues of technological access but also financial, content, political, regulatory, organizational, socio-cultural and ethical issues involved. Underlying these constraints is the constant tension between calls for standardization and the requirements for flexibility of applications in the contexts of the Global Information Infrastructure, the National Information Infrastructure, and the Local Information Infrastructure.

Technological Constraints

97. Discussions on ICTs for developing countries tend to concentrate on the issue of access to the technologies themselves. For example, despite rapid progress in the last year, no more than 15 African countries have full access to the Internet and some remain without any electronic connectivity at all. In 1994, the average "teledensity" (number of main lines/100 inhabitants) in Africa was only 1.6 as compared with 45.0 in Europe (UNECA, 1996).

98. Paradoxically though, unencumbered with decades-old copper wire, some developing countries that have made communications a priority are installing digital switches, fibre-optic lines and the newest cellular and mobile technology. For example, the most sophisticated national networks are in Djibouti, Rwanda, the Maldives and the Solomon Islands, where 100 per cent of the main lines are digital, compared with 49.5 per cent in the United States of America (de Cuellar, 1995).

99. And for the approximately three billion people who have no telecommunication network connection, there are some promising alternatives appearing. One approach to benefiting optimally from existing facilities is for the users to creatively apply other available technology to develop needed services. For example, broadcasters in several African countries are making use of the multi-point multichannel distribution system (MMDS) technique to retransmit international satellite channels to viewers equipped with microwave receivers, without the cost of laying cable. Packet-radio can also economically compensate for poor terrestrial networks. In several countries of Latin America and the Caribbean, where the terrestrial telecommunication networks are severely overloaded and geographically unbalanced but there is good international satellite coverage, VSAT technology is being introduced as an immediate solution for priority applications (e.g. Argentina, Brazil, Mexico, Peru) (ITU and UNESCO, 1995).

100. The age of informatics equipment is a problem to be reckoned with in many developing countries. In many cases, there may be a problem of compatibility between technologies, and with systems not being fast enough to run, for example, Internet applications. Previous experiences with technologies serve to raise the spectre of technology obsolescence, in which ministries have invested heavily in a particular technology and found it out of date in a few years. In confronting these problems it is essential to understand the process of rapid technological change and to formulate knowledgeable, but flexible, strategies to move forward. Cooperation and exchange of experience at the national, regional and international levels will clearly be on asset in this context.

101. Serious constraints also exist due to lack of reliable sources of power for various technologies. The availability of electricity is still very poor in developing countries. There is also a lack of redundant links and back-up equipment in many cases which tends to limit the reliability of applications. Alternatives in low-cost integrated solar power and battery recharge systems are being considered (UNDP 1996).

102. Finally, an emerging issue which has implications for developing countries is the exponential growth of Internet traffic, fueled particularly by exploding numbers of WWW servers and users, which has created chronic congestion that impedes efficient use of the Internet for certain purposes. This is compounded for users in developing countries who typically have slower equipment (computers and modems) and generally lower access bandwith than counterparts in the industrialized countries. Efforts will needed to be made to optimize configurations among stand-alone, intra-net and Internet tasks, and to improve procedures for organization of and access to the Web as discussed later.

Financial Constraints

103. The high cost of ICTs constitutes the major obstacle for developing countries. The costs are typically discussed in four areas: infrastructure, hardware, telecommunication tariffs, and content. Infrastructure costs loom very high for developing countries. It is anticipated that developing countries as a whole will be spending some 200 billion dollars in the next five years in order to build over 300 million main lines and upgrade their present telephone networks (de Cuellar, 1995). In addition, funding is required to build sources of increased power for these facilities. Developing countries are constrained in their ability to negotiate favorable terms with multinationals, particularly as they are often competing among themselves for a limited supply of international capital. There is also difficulty in obtaining local capital for start-up and expansion activities.

104. The problems of developing countries in meeting meet their financing needs are often further exacerbated by inefficient and bureaucratic policies and practices. For example, it is estimated that US$ 28 billion will be required to achieve the goal of installing a telephone line for every 100 people in sub-Saharan Africa, but, if installation costs could be brought down to global industry norms, the same goal could be realized for US$ 8 billion (d'Orville 1996).

105. The cost of ICT hardware also poses significant challenges, although this should ease over time with significant price and performance gains. The cost of personal computers with basic network connectivity is already approaching US$ 500, and the recent introduction of the Network Computer by Oracle, IBM, Sun Microsystems and Netscape will allow people to connect to the Internet without requiring them to own a personal computer. Compounding the cost of hardware is, however, the fact that many developing countries have high levels of import duties on information technology and communication equipment. These have been established in many cases to protect local industry, but they may also be making needed hardware inaccessible to key sectors of society.

106. Tariffs for telecommunication services and facilities needed in the sectors of public concern - notably data communications, electronic mail, leased lines and facilities for TV programme exchange - are often especially high in developing countries and hinder progress and innovation in the area of telematics. The low income countries (mainly in Africa and Asia) achieve an average level of profit on telecommunications operations which is more than three times that of the world as a whole, despite the fact that they gain less than US$ 3 per person per year from their inhabitants. This apparent paradox can be explained by the fact that the relatively few people within these countries who have access to telecommunications services can afford to pay high prices. In theory, these low income telecommunication operators should have the lowest level of profitability because they should be operating major investment programmes. However, this does not appear to be the case. Rather it appears that governments in these countries prefer to use the telecommunications sector as a cash cow to pay for other parts of the economy and projects unrelated to telecommunications (ITU 1994).

107. The trend towards cost-oriented tariffs, both nationally and internationally, poses additional difficulties for the sectors of public concern. There is an enormous gap in the tariffs being charged for telecommunications and telematics services and the amount of money which publicly funded institutions, such as schools, libraries and hospitals, can afford. There have

been serious efforts, through the use of special "educational" tariffs, and these will no doubt encourage both the use and provision of telematics services. News agencies and broadcasting unions in developing countries are in most cases legally non-profit organizations and for many years have attempted to obtain lower telecommunication tariffs. The following examples reflect some of the solutions envisaged in developing countries (ITU and UNESCO, 1995):

- In Colombia, discounts of 15-35% are offered to the higher education sector for use of the national public data network, and fees for dedicated connections to the Internet are substantially reduced for institutions in this sector.

- In the Dominican Republic, a promotional and reciprocal traffic agreement with a national PTO provides for free connection of the research and academic community to the operator's public data network and to the Internet.

- In the Arab States the 1992 Regional Telecommunication Development Conference sponsored by ITU/BDT requested that national telecommunication operators: "exempt Arab TV organizations from payment of ground sector charges for news and programmes transmitted on ARABSAT TV channels leased by Arab States Broadcasting Union" with the further provision that any charges for the ground sector "should only be promotional and reduced to the minimum possible".

108. Although there are may examples of tariff reductions granted to the media throughout the world, they have probably been a less satisfactory solution in developing countries than reductions for education, due to the fact that the media are major users who require large stable concessions rather than promotional arrangements.

109. Moreover, the issue of offering preferential or concessionary tariffs remained unresolved. From the user point of view, the same basic question of strategy is being posed: How much emphasis should be given to seeking preferential treatment for specific sectors as opposed to focusing on reducing tariffs for the users as a whole? Sustainable solutions in today's competitive telecommunication environment are more likely to involve adequate user investment and user negotiation with operators on the basis of consolidated commercial demand, rather than long term subsidies (ITU and UNESCO, 1995).

110. Lastly, the cost of producing and marketing applications and content represents another major hurdle facing developing countries, most of which are forced to buy extensively from the industrialized countries. For example, the software market is dominated today by the United States, Japan, Germany, Britain and France. The only developing country to even crack the top-10 of software producers is India. But, India remains primarily an executor selling its services and software abroad with relatively very few products being developed for its own indigenous needs. The situation is not satisfactory to the industrialized countries either, since it results in the fact that much of the software and content available in developing countries is pirated.

111. There is some fear that similar conditions will prevail in the area of telematics services with parts of the World Wide Web becoming commercialized. Some information which was previously "free", is now becoming an economic good. The inability to pay for information and services, even if one has connection to the Web, becomes an additional barrier to access. However the overall tendency seems to be that the Web will keep expanding in terms of

information freely available to the international community as organizations and individuals find in it new possibilities to share information and to promote cultural expression, as well as to develop professional and commercial services. It is expected, in addition, that the development of "applets" to be downloaded from the Internet will dramatically bring down the cost of some software, which may soon benefit end-users.

Content and Interface Limitations

112. The question of access to content involves deeper issues than simply costs. There are strong concerns over very little diversity and relevance of content, particularly at local levels, as well as low production quality in developing countries. Most content is produced either in the industrialized countries or in the urbanized capitals of developing countries. It often fails to reflect the physical conditions, the culture, the experiences and the development priorities of many current and potential users. In addition, there is a growing phenomenon in which access to the Internet is constrained by too much information and too little bandwidth, particularly in developing countries. Criticisms, are emerging, for example, against the World Wide Web as a large depository for "cyber-junk".

113. If present estimates hold, by the end of 1996 there will be a staggering 150 million pages on the Web, containing 50-60 billion words. A major challenge will revolve around the ability to locate and retrieve content. Part of the solution will come from ever more powerful search engines and browser programs with built-in subject knowledge and superior caching and index structures (d'Orville 1996). But it will also be important to involve user groups with common interests, particularly in the developing countries, in efforts to structure, index and maintain useful information at the input stage to ensure effective subsequent access.

114. Language can also be a serious barrier to access. For example, today, a majority of the information available on the Internet is still in English, and the principal "browser" software widely used to access the information cannot identify and effectively present non-Roman scripts. Such a situation serves to exclude the wide variety of users who do not read languages originating in Western Europe. Developing countries may want to consider adopting software that supports multiple languages and translation systems to allow on-line dialogue between people using different languages (d'Orville 1996).

115. Another problem is that of illiterate users excluded from the information revolution no matter what language they speak. Developing countries may want to consider developing special applications with simple interfaces, or voice-based systems for illiterate populations. Other innovative interfaces, often involving similar technical solutions, can help the physically handicapped, such as those with hearing, vision or motor disabilities, who find it difficult or impossible to use existing telematics services.

116. It is important, not only for the issue of access but also for that of diversity, that the production of localized content in many different languages be supported. However, today there is a lack of appropriate enabling environments (facilities, equipment, training, etc.) for the creation of local information products and materials.

Ethical and legal constraints

117. Several ethical and legal constraints stand in the way of developing countries. Such constraints have tremendous impact on the free flow of information within countries and with the rest of the world. Underlying these constraints are several ethical questions that countries and peoples must resolve. For example, should all people have access to all types of information and for that matter all types of ICTs? What should be the basis for determining levels of access? Who should make these decisions? It is evident in this context the principle of "ability to pay" is not one that is sufficient for guaranteeing equitable access to ICTs and information.

118. Two legal issues stand out for developing countries to place on their agendas: freedom of expression and intellectual property rights.

119. Freedom of expression is a universal principle which is incorporated, for example in Article 19 of the Universal Declaration of Human Rights which reads: "*Anyone has the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers.*" In the area of electronic media, however, some difficult issues have been raised that have yet to be adequately resolved by either industrialized or developing countries. One way of casting the debate is in terms of "desirable freedom" versus "unacceptable license". The extent to which this freedom should be granted has been widely discussed, and policies and levels of censorship vary considerably among countries. The question of when there is there too much freedom is answered in large part by seeing when it encroaches on the rights of others.

120. Two specific problem areas are of paramount importance regarding freedom of expression. The first relates to privacy of information and the right of individuals to restrict access to, or verify, data pertaining to themselves. The second concerns information of an intolerant, racist, violent or pornographic nature, and particularly its access by children. These broad and difficult problems have been largely addressed by the relatively few countries which have the infrastructure and resources to resolve them, but will also have to be considered by others and particularly the developing countries.

121. Several approaches serve to provide some guidance for dealing with the problem of socially unacceptable content which is the more complicated one because of its wider cultural implications (de Cuellar, 1995). First, there is international legislation. For example, the Convention on the Rights of the Child, adopted in 1989, provides an international normative framework by referring, in its Article 17 dealing with the media, both to the need for State parties to ensure that children have access to information and material from a diversity of sources and to "encourage the development of appropriate guidelines for the protection of the child from information and injurious to his or her well-being ...."

122. Another approach that has been invoked by certain countries is to ban certain technologies. The banning of satellite dishes by certain states is a response to the objections that these countries have to the programmes broadcast. In the case of the Internet, certain technologies are being used to restrict access to information. Such measures represent attempts

to exercise what regulators call "the right to refuse" which has been implemented, for example, in several Asian countries. Ultimately, because of the nature of the technology, this right is probably largely illusory in practice.

123. A third approach is voluntary standard-setting practices. Some countries, extending the well established systems for rating films, are promoting the introduction of codes for broadcasters to voluntarily classify the material they show (by designating some programmes for universal viewing, others as unsuitable for children, etc.). Analagous coding systems are being introduced for the Internet, based, for example, on the Platform for Internet Content Selection (PICS) standard developed by the World Wide Web Consortium. The comprehensive study recently completed by the Australian governement on regulation of the content of on-line services provides an interesting model for such efforts (Australian Broadcasting Authority 1996). These initiatives reflect a growing acceptance for ideas such as a "safe harbour" period for family viewing and the formulation of "family viewing policies." User operated blocking devices based on agreed classification systems are being introduced or considered by several countries to facilitate the implementation of such policies.

124. Finally, efforts are also being made to encourage media literacy in countries such as the United Kingdom so as to arm parents with the information required to make sensible decisions regarding what type of content is viewed in their households. In addition, efforts are being made to better enable parents and teachers to discuss and mediate what children view.

125. Intellectual property rights represent a second critical constraint that must be considered by developing countries. Intellectual property is becoming a major factor influencing the development of information use and its protection. The crux of the debate on this issue revolves around the free circulation of works versus the effective protection of rights. The basis of intellectual property protection has always been a balance among the interests of three concerned parties: authors and performers, investors and users.

126. There is controversy over whether digital technology will disturb this balance enough to require changes in the basic framework, or whether adaptations will suffice (such as the exceptions to the general rules which already exist in many cases). The globalization of information networks, the integration of different types of works in multimedia, and the fact that digitalization makes works easier to alter and more difficult to keep track of, pose problems of harmonization of national approaches to intellectual property.

127. Although in principle the means of transmission should not influence intellectual property protection, creators and producers of intellectual works believe that additional measures will be needed to protect their rights in the digital age (UNESCO, Symposium on Copyright and Communication, 1996):

- Rights protection for most types of electronic works can be ensured through the basic framework of the Bern Convention, but, as electronic distribution becomes the most important means of dissemination, major changes may be required in rights concerning phonograms and broadcasts, perhaps by granting their authors and producers an exclusive economic right. The problem of non-authorized introduction of works into electronic networks will require particular attention.

- A major challenge for all intellectual property rights is seen as how to monitor access to and use of

works in a digital environment. For this a unique identifier has been proposed, similar to the ISBN scheme which has been operational for 25 years for books. Issues like security and confidentiality are seen as very important in implementing such a tool, as is the depth to which parts of works would be identified.

128. On the other hand, the trend towards electronic publishing is constantly lowering the costs of services provided by intermediaries between the creator and the end-user (presentation, dissemination, marketing), thus resulting in pressures for lower usage charges. And excepting literary and artistic works that are clearly in the commercial domain, there is a vast amount of information which derives from the public domain, with varying degrees of added value, and should be able to be made available to the public through ICT based means at nominal cost or free of charge.

129. Collective administration of rights can provide solutions which are less cumbersome than individual negotiations and provide economic benefits both rights holders and users, but such schemes can be ineffective or even harmful if they are established without proper safeguards and consultations among the concerned parties. Different categories of rights holders have applied collective administration with varying degrees of success, and the harmonization of rights regimes should facilitate the standardization and generalization of this practice. The establishment of special schemes for "near public domain material", with payment on a block subscription basis or through the public authorities, is a possibility worthy of serious consideration.

130. ICTs can also provide solutions, for example through automatic registration of copyright claims, or mechanisms to monitor access to protected works. The fundamental questions in this approach do not concern technical feasibility but rather the degree to which such efforts are required, the need to ensure respect of the privacy of the users, and the mechanisms to pursue in case of infraction (e.g. jurisdiction of the country of the server, the country of the producer of the work, or the country of the user).

131. To these problems are added difficulties in clarifying the application of existing procedures to computer-generated materials. As an example the 1950 Florence Convention exempts educational, scientific and cultural materials from customs duty, but there is not universal agreement on its relevance to computer-readable materials or to educational materials developed or distributed in a market-oriented context. Users, producers and governments must be actively involved in resolving these questions.

132. Finally, there is the very important concept of "fair use". In the pre-digital world, this Jeffersonian concept ensured a balanced attenuation of the rights of intellectual property owners in favor of information users. Thus the very idea of library was made possible. But with the rapid advance of digitalization, some copyright holders are questioning the very existence of fair use for electronic media. This difficult problem should be carefully analyzed and monitored by governments with the involvement of the international community at large.

Political and institutional constraints

133. The problem of resistance to change is particularly important in many developing countries. For example, there tends to be political reluctance to review and modify national

policies regarding ICTs, processes for implementing new technologies, organizational structures and procedures, and regulatory measures.

134. The last report of the Club of Rome stressed that co-ordination is becoming more critical to governance than efficiency (UNESCO, Symposium on Copyright and Communication, 1996). However, there is often insufficient effort to cooperate with other leaders within a country and between countries. Although highly desirable, it is often quite difficult for organizations such as government ministries, the private sector and NGOs to really work together because of different organizational cultures and attitudes.

135. National regulatory restrictions grounded in centralized state control also stand in the way of access. Distribution channels are tightly controlled in many countries by bureaucratic entities. For example, in many developing countries, there are prohibitions on the creation of private telecommunication networks (whether based on user-owned or on leased facilities) and/or on obtaining the required interconnection with the public networks. It may also be very difficult to obtain licenses for broadcasting and for accessing international telecommunications carriers.

136. Pressures for change have come mainly from concerned citizens groups and enterprises. In the 1990s, for example, over 700 "illegal" radio stations were set up in Turkey, challenging a law which gave a monopoly over radio and television broadcasting to the state authority. In sub-Saharan Africa, there has been a movement to deregulate broadcasting from the hands of the government. For example, Mali is a showcase for private broadcasting with more than fifteen operational private radio stations, while the National Broadcasting Commission of Nigeria has granted licenses for one radio and six television stations as well as eleven cable/satellite retransmission stations. Many such stations appear to be following in the footsteps of their mostly commercial counterparts elsewhere, focusing their attention on advertising and entertainment-oriented programming, and licenses have tended to be granted to individuals with close connections to the government, but the evolution towards more open, competitive and pluralistic systems is a healthy one. Similar tendencies are developing for the establishment of private value-added telecommunication services and Internet providers in developing countries (de Cuellar, 1995).

Human resource constraints

137. The ability to effectively access ICTs in developing countries is severely constrained by lack of human resources in those countries. On one level, users lack the minimum level of "digital literacy" required to make effective use of and choices around ICT opportunities. Such "literacy" starts with basic skills in using, for example, computer terminals but then also extends to much higher level skills of searching, filtering, selecting, and analyzing available information.

138. On another level, there is a tremendous lack of technically trained personnel required to support National and Local Information Infrastructures in developing countries. For example, information specialists need to learn how to design and implement information systems in different applications and national sectoral databases; to capture data, build and administer databases and decision support systems; and to build information servers on the Internet. In

addition, information service providers need to know how to analyze user needs and identify what information services their users require; to access information available from national, regional and international sources; and to establish systems for updating data on a regular basis. Also, telecommunication and networking specialists need to learn how to plan, design, install, operate and maintain communication and information networks. Unfortunately, most developing countries seriously lack such specialists and the programmes and facilities for training them.

139. Some of the industrialized countries are beginning to undertake creative means to address the problem of widely disseminating ICT know-how. In the United States, Tech Corps has been created as a national, non-profit organization of technology volunteers dedicated to helping improve K-12 education at the grassroots level. The mission of Tech Corps is to recruit, place and support volunteers from the technology community who advise and assist schools in the introduction and integration of new technologies into the educational system (McKinsey & Company 1996). Proposals have been made to extend this concept to the international level through a volunteer corps which would work in public sector institutions in developing countries, and could use the Internet to further share and reinforce the expertise available in these institutions.

Socio-cultural constraints

140. Finally, very real and debilitating socio-cultural constraints exist in developing countries which may prevent certain groups of users from accessing different ICTs. Various forms of discrimination which exist in countries extend into the realm of ICTs. Women, for example, generally tend to have more limited access than men to information, the media and communication facilities. Certain minorities also face serious constraints as do the under-educated or illiterate. Age hierarchies may also restrict access to younger groups. Overcoming such constraints will require that specific actions need to be targeted especially at disadvantaged groups.

V. ACTION NEEDED TO RELEASE THE DEVELOPMENTAL POTENTIAL OF ICTs

141. The exploitation of ICTs, particularly through the Internet, has grown spectacularly in recent years, outdistancing efforts to plan and control their growth. Economic and commercial interests have been the main driving forces for the spread of ICTs. One of the results to date of the spread of ICTs has unfortunately, even in industrialized countries, been an increase in inequities between certain strata of society. These iniquities result in large part from differences in ability to pay for ICT access, but have much more serious roots and consequences; in effect, in today's society those excluded from access to electronic information resources are excluded from participating in the new global culture that is empowered by use of these resources. It is therefore essential that someone look out for the interests of the marginalized groups of society. It is necessary to identify those critical areas within each country that are not profit-generating activities, and to make sure that the government or non-profit sector provides for required ICT applications in these areas and ensures that they are available to all citizens in

need of them.

142. At a deeper level, the emergence of an Information Society poses challenges to both democracy and learning. The biggest challenge is not opening up access to new technology, important though this is. Rather, it involves preparing new perspectives, structures, strategies, skills, and knowledge as well as developing new levels of understanding in order to surmount the growing array of complex social, political, economic and ecological problems confronting all countries. In addition to helping to address these concerns, ICTs also increase the complexity of them. On both of these levels, it becomes quite obvious that culture, education and science, as distinct and integral parts of our civilization, cannot be left totally at the mercy of market forces. While information technologies are providing partial solutions to emerging problems, such as "cyber-locks" to prevent viewing by sensitive audiences or mechanisms for ensuring the integrity of digital works, there is still a need for certain policies and a policy framework. This is particularly the case when trying to address issues of cultural diversity and creativity, educational opportunities, public participation, social awareness and responsibility, and promotion of tolerance and peace.

143. This section seeks to recommend key areas for policy initiatives to be pursued by governments in order to stimulate greater access to the benefits of ICTs by developing countries and specific user-populations. In addition, flexible but coherent policies are needed to protect the interests of the end-users and the creators and distributors of information products and services within the countries. These policies must be addressed at all three levels: the Global Information Infrastructure, the National Information Infrastructure, and the Local Information Infrastructure. This will not be easy. The difficult challenges will lie in i) negotiating consensus and consistency of policies on these three levels, particularly between the developing countries and the industrialized countries; ii) facilitating implementation of the policies; iii) monitoring the degree to which policies are successful and modifying them accordingly. There currently exists a real tension as to what extent ICTs should be regulated by governments, and increasingly, by regional cooperation bodies. This concern may be partially justified as it stems from an understanding of the heavily bureaucratic conditions in which most governments operate. It is therefore critical that both the governments of developing countries and their peoples become involved in these policy discussions and efforts to regulate the ICTs. Such involvement will require a shift away from top-down models of policy formulation. Over time, new systems of organization at the national and/or community levels may evolve to assist with these processes. The technologies themselves might help to constitute new public forums for closing the gap between policy makers and their constituencies. Several sets of policies that should be addressed are identified below.

Legal and Ethical Frameworks

144. Governments and communities may have to enact laws to protect the interests of users, creators, producers and distributors. Developing countries must seek to actively participate in the process of reviewing various international conventions to ensure that they are relevant, effective and fair. Although there should be maximum flexibility in the interpretation of these laws, governments may want to consider strong penalties for violations of them. However, there is the real problem of enforcing these laws, particularly on a global level. Therefore, to the extent possible, efforts should be made to promote voluntary regulation, especially at local

levels.

Intellectual Property Rights

145. The application of intellectual property rights should be adapted to the new technological environment, e.g. online access, which implies the existence of most works in non-physical form. Protection in this environment increasingly depends on the legal and financial resources available, and steps should be taken to extend equal protection to all authors and creators. In particular, measures must seek to catalyze reflection on the issue of artistic integrity and moral rights which are endangered by new technological possibilities for distortion and for distribution of distorted works. Developing countries should seek to develop an appropriate copyright policy which tries to strike a balance between respect for intellectual property - as an incentive to creation, a means of protecting national heritage and an international necessity - and the provision of basic intellectual needs of society, particularly the disadvantaged and the sectors of public concern. Governments should spread awareness to the public about intellectual property rights and, at the same time, undertake schemes for reducing the negative effects of these rights on society as a whole.

Freedom of Expression

146. Developing countries must seek to establish policies on freedom of speech issues which address areas of attribution, integrity, anonymity, autonomy and accountability. Within this context, it will be extremely important to reflect on issues of censorship both in terms of certain technologies as well as in terms of harmful content. This issue of censorship will be especially sensitive in countries where the government has maintained strong centralized control over access to information in the past. It should be anticipated that it will be very difficult to consistently judge the "offensiveness" of the same content in different cultural settings.

147. Developing countries should review their policies of restrictions on freedom of expression, including measures to ensure law and order or national security, which may be inappropriately applied to ICTs. Although new legislation or other measures may still be required to restrict pornography, hate speech, and other socially destructive behaviour, as experience in industrialized countries is showing, it will be difficult to enforce new laws. Ultimately, progress on the free speech issue will hinge upon efforts to develop a balance between anonymity and accountability. In this context the differences between the traditional broadcast and printed media and the new information highways should be carefully considered by the concerned authorities.

148. In addition, with the new ICTs, there is an increased risk of falsifying and tampering with information. Standards for encryption and data security should be developed to ensure the integrity of information and privacy of individuals. Legislation should also be drafted against cybercrimes such as cybertheft and piracy.

Privacy

149. The government has an important role to play in securing citizens' privacy through adopting laws to protect its people against invasion of their lives through the new technologies. Developing country governments should therefore formulate clear policies regarding electronic recording of personal data and means for controlling its use in relation to privacy protection.

Allocation of communication capacity

150. Another important question that might merit legislative action is the designation of "public space", that is, how to share the available communication capacity among and within countries. As Alvin Toffler has stressed, "the [electromagnetic] spectrum ... like the ocean floor and the planet's breathable air, belongs - or should belong - to everyone, not just a few." The assignment of frequencies and service licenses is in fact only part of a wider process determining access to the public communication space. Private and transnational interests have claimed a disproportionate share of this space in many developing countries, while in others monolithic government interests still hold monopoly control. Developing countries should seek to claim their rights in this public space and then develop mechanisms for apportioning it to users. Reapportioning public space will involve carefully relooking at International Law *vis-a-vis* national laws (de Cuellar, 1995). One recommendation that has been proposed as part of an open-entry spectrum system is that governments charge fees for actual use of spectrum instead of auctioning exclusive licenses. In addition to permitting more open access, this approach would ensure continuous flows of revenues and not only a one-time auction income (d'Orville 1996).

Jurisdiction

151. In all of these areas, leaders from all over the world will have to consider issues of jurisdiction. Existing laws and frameworks for enforcement did not foresee the development of the GII. Conflicts involving transborder interactions will be particularly difficult to resolve. As happened years ago with law of the sea and outer space law, a "cyberspace law" may well become necessary as a separate legal discipline, able to promote and protect diversity and universality in the global information village. Developing countries should seek to actively participate in forums for drawing up an alternative body of legal principles applicable to cyberspace (UNESCO, Challenges of the Information Highways, 1996).

Local access codes

152. Institutions such as schools, universities, libraries and local governments should also be encouraged to take responsibility for procedural and ethical aspects of ICT use which are important for their users, by developing their own electronic information access policies modeled on community, national and international practice. For example, such a local policy for a school system might state that only Web sites that have educational and instructional value will be accessible, and define the standards to be applied to identify these sites and applications. The policy might also state how these standards will be reviewed and modified. If software filters will be used to limit access to portions of the Internet, this could also be stated. Such a policy should also address the ethics of computer-based information access through a code of conduct covering software piracy, unauthorized access and confidentiality (Zenor, 1996).

Incentives and Subsidies

153. Incentives and subsidies may be a stronger mechanism for encouraging and discouraging certain types of behavior concerning ICTs. Countries should strongly consider, in the framework of their development priorities, the subsidization of services in some specific sectors of public concern, particularly those that are less well endowed. Institutions such as

schools, hospitals, research institutes, universities and public media should be considered for such subsidies, which should generally apply for a short period of time in each case with the aim of creating infrastructure to support the concerned sectors. The highly successful experience of telecommunications in the now-industrialized world provides a sound historical precedent for such measures.

Tariffs

154. Telecommunication regulators in developing countries should facilitate the granting of lower tariffs to the sectors of public concern, taking account of their specific needs and of the commercial interests of the carriers (ITU and UNESCO, 1995). It is in the long-term interest of telecommunication entities to accord users in sectors of public concern "most valued customer" status and to give them high consideration concerning access, flexibility and pricing as is done for large government and business customers. The principle of "non-discriminatory" tariffs should be reviewed when applied to sectors of public concern. There are a number of mechanisms already in place (e.g. off-peak discounts, high-volume discounts, experimental tariffs) which fall within the practical definition of non-discriminatory treatment, and can be applied imaginatively to spur development through telematics.

155. In addition to an improved policy and tariff environment, end-users would benefit from stability and predictability of tariffs. Researchers, educators and other public sector users are, unlike corporate telecommunications customers, unlikely to be able to pass on costs, and it therefore becomes particularly important for them for costs to be transparent and predictable.

Tax exemptions

156. Governments should consider providing tax exemptions to selected user groups on the purchase of hardware and software locally as well as from abroad. Also, governments may wish to consider progressive tax exemptions for telecommunication operators and value-added service providers which are serving the needs of marginalized communities. Such measures should be seen as incentives facilitating access to ICTs for development, in partnership with entrepreneurs and commercial interests which would otherwise be unable to immediately provide needed access at affordable cost.

Second-hand market

157. As large corporations regularly replace their ICT equipment, an immense and abundant second-hand market is in formation where, at a small fraction of original prices, ICT hardware and software can be obtained. The scope of these new opportunities is leading to a re-examination of proposals to use them to assist poorer countries and public sector institutions to acquire information technologies appropriate for certain applications under favorable conditions. Efforts in this direction, facilitated by development cooperation incentives in the industrialized countries and support from the corporations concerned, should make sure that the receivers understand the limitations of the equipment and are able to maintain and effectively use it. Additional incentives might need to be considered to encourage content producers to produce for the older platforms (d'Orville 1996)

Content Quality

158. The shortage of quality content will be a critical issue facing ICTs. Governments should seek to develop a code of positive content and harmful content for creators, producers,

distributors as well as end-users. Accreditation or a "seal of approval" can be awarded to companies and institutions who produce content that adhere to this code. It would useful for a comprehensive rating system to be developed and promoted in public awareness campaigns. Distributors would then be encouraged to mark their products with such ratings and appropriate warnings.

159. In addition, a fund for producers and creators of content with positive socio-cultural value might also be developed. Such a fund should be especially targeted at creators and producers who work on a small scale or are from marginalized groups, and could also be used to support efforts to maintain linguistic pluralism. It should actively promote partnership between content specialists and media specialists as well as cooperation between them and educational and research and development programmes, to promote innovation and develop sustainable markets for ICT applications in sectors of public concern. Such a fund might be administered by an independent body to free it from political pressures.

160. A related and interesting proposal concerns the use of micro-credit schemes to support the production of local content (d'Orville 1996).

Public Domain and Public Access

161. The information market is taking care of itself with its powerful means. Although there are imperfections and constraints for certain producers, particularly in developing countries as discussed above, in general whatever may have a market value is disseminated and may generate a fair return. However, there are huge areas that the info-market seems to neglect, for different reasons: insufficient expected profitability, small readership, or more paradoxically, the public nature of the original data. For instance when data is produced by official or governmental bodies, it may not be promoted as aggressively and as widely as it would have been if the same information had been produced in a private environment. It is an avatar, in the information industry context, of the famous "tragedy of the commons" paradigm. When something belongs to everybody, nobody in particular seems to be motivated to take the care of it. Immense reserves of such "public domain" information are thus often not well enough known of potential users, just because nobody seems to be willing to take the initiative to promote access to them, no direct profit being expected due the very "public" nature of the information. Governments, public organizations and NGOs have very rich and diverse information which should be inventoried, digitalized and made available to the public using appropriate information technologies. To this store should be assimilated other information which is free of copyright because it has fallen into the public domain (including most of the artistic and literary masterpieces of the past). Another line of development of this "public domain on line" concept is a growing amount of information produced by persons who are willing to let their intellectual production be disseminated widely without trying to get a financial return, on the condition that their name be attached to the information thus relinquished.

162. The above questions of access to information, and particularly that of promoting a vibrant public domain while protecting legitimate private interests, are key policy concerns of developing countries. The Internet, given its strategic nature, should be considered by

governments as a public utility tool, a fundamental objective, particularly in developing countries, should be to keep the cost of Internet accessibility as low as possible.

163. International organizations should assist by providing advisory services to governments on the establishment of national and regional policies to extend public access to information, making appropriate use of ICTs. Examples of two lines of action in this area are presented below:

Government on line

164. Around the world governments are seeking to improve their efficiency and impact in response to rising expectations of citizens and financial pressures on the public sector. The information technology revolution is providing major opportunities to help governments respond to these new needs, and developing countries are poised to benefit particularly from these opportunities, provided that they adapt their action to national and local conditions:

- Governments can particularly benefit from the virtual community concept to improve efficiency through better access of their officials to internal and external information. Telematics technologies can be employed within governments, particularly as internal Internets or "intra-nets" to facilitate internal access to regulations, procedures, policies, correspondence, and documentation, to ensure seamless links to external databases and contacts through the international Internet, and to provide decision support tools which make use of all available information.

- Government services can be made more efficient if citizens can quickly learn on line where to obtain them through databases which also contain information on the related administrative requirements. As a further dimension, interactive applications can save citizens' time and government expense by enabling people to rapidly and efficiently provide information needed by government. In developing countries, on-line government can readily be provided in government offices or special community centres, using custom interfaces accessible to the target populations including illiterate citizens.

- Citizens can be enabled through ICTs to provide feedback on policy and problems and to more actively participate in the democratic process. In this context, information technologies are particularly useful to local and community governments, which are widely receiving increasing authority and responsibility without necessarily having commensurate physical infrastructure and financial means. Telematics technology can enable the civil society to receive, generate and disseminate information on community life, can put a community "on the map" nationally and internationally, and can be used by local authorities to poll opinion. Much can be done in these directions with a single point of access in a community centre.

165. The concept of on-line government could be further developed through regional and international cooperation. For example, the establishment of Internet links between Parliaments and their world organization, the Inter-Parliamentary Union would make it possible for databases on legislative debates and decisions to be available internationally at very low costs to the poorest Parliaments.

Public telecentres

166. Governments should also seek to support the establishment of public "telecentres" which provide people with access to development-oriented applications and content as well as needed ICT based facilities with associated training. Such telecentres can be seen as the community libraries of the future and as a critical component in supporting the goal of equal access to cyberspace. They could be used to support the generation of local content, and discussion and reflection on content. They might also be used to provide local access to radio and television production facilities.

167. The ITU has been promoting the telecentre concept for several years, and has in particular demonstrated how such centres can become sustainable and largely self-supporting while fulfilling essential development functions. Existing public facilities such as schools, hospitals, libraries, community centres, post offices, etc. might be initially targeted as sites with the idea that all organizations providing information content for development - both governmental and non-governmental - should cooperate in developing services and applications. The role of public libraries and of library and information professionals as natural gateways to information resources should be given special consideration in this context. In areas where appropriate community and public facilities do not exist, governments could offer land subsidies, exemptions, basic equipment, infrastructure linkages, etc. to organizations or individuals wishing to build and run telecentres, which might be best developed on a cost-sharing basis with local communities. The feasibility of establishing mobile telecentres could also be considered. In any case, strong efforts should be made to support interactivity among public telecentres in order to achieve levels of public participation and market development necessary to ensure wide benefits of ICTs in society.

Technology Standards

168. The challenge for developing countries will be to develop cheap, simple and robust technologies using flexible, modular, and scaleable network designs for coping with increasing users and traffic. Standards are important to the creation of "models" or "frameworks" within which future networks and services can evolve. Ideally, such models should be based on "open" standards, that is, not restricted to proprietary specifications. The adoption of a set of flexible standards that are adapted to the conditions in developing countries will be essential for certain cost-efficiencies to be gained in these countries. Standards should also reflect the financial realities of developing countries, which have limited budgets and as a result much longer product purchasing cycles than their counterparts in the industrialized world. Once users buy into a certain technology it may be quite difficult for them to change it for several years thereafter.

169. Telecommunications and related information technology standards have not, until now, been a major issue for the sectors of public concern. However, the technologies now being employed by networks are heavily influenced by standards promulgated by the ITU and the International Organization for Standardization (ISO), as well as by *de facto* standards developed, for example, by the Internet (which uses the TCP/IP protocols). Governments and end-users in developing countries should become jointly involved in efforts to harmonize the existing standards and develop the future ones (ITU and UNESCO, 1995).

Training and Research

170. Training will be required at many different levels by many different users to avoid their becoming passive recipients. Training programmes should be developed to make decision makers in developing countries aware of the opportunities that ICTs offer as well as of their potential pitfalls. They should explore how existing and emerging technologies can be applied to development goals. For example, ministries of education must be made aware of different technologies in order to consider how these can be applied in their education systems. Moreover, decision makers should also be knowledgeably equipped to decline certain technologies. In some developing countries, literally thousands of technology sales people are trying to sell their products to the government with high pressure pitches and promises. The decision makers unfortunately are often not well equipped to make decisions concerning these confusing options. The general public also needs to upgrade its level of computer and media literacy to be aware of the importance of information availability and usage. Courses should be developed in this context for schools as well as adult education populations.

171. Developing countries should also ensure the education and training of specialists needed to develop networks and ICT based applications. Both university-level education and practical continuing education are required; they should cover both technical and management concerns and take full account of both the latest international developments and the national socio-economic and cultural context. Various modalities of public sector/private sector cooperation should be considered to ensure the establishment and full exploitation of needed education and training facilities. Regional cooperation may provide an effective means for building critical facilities which are outside the reach of a single country, at least in the immediate future.

172. As a complement and component of education on ICTs, developing countries should support research on innovations in their use by different populations and on their effects on society and development. Additional research and development activities should also be considered around the idea of promoting equal access to cyberspace, i.e. how new cost-effective approaches could be developed to overcome the various barriers to access. Universities and other centres of learning should be seen as key resources in these efforts, and should in turn envisage various strategies for collaboration with telecommunication operators and private enterprise which can bring the results of research to the market while providing needed revenue for public sector research and network access. An interesting model for the international cooperation in this area is the UNESCO Chairs in Communication (ORBICOM) network established to promote higher education and research in communication through collaboration among academic members and industrial associates (ORBICOM 1996).

Cooperation

173. Efforts to support cooperation among individuals, communities and countries will be critical in promoting access to ICTs in developing countries. Developing countries should seek to establish a framework and mechanisms that ensure the participation of all sectors in implementing the national information and communication infrastructure and co-ordinating and harmonizing the multiple efforts of the different players, including the private sector, NGOs, telecommunication administrations and operators, researchers, teachers, and the media. It is especially important to ensure the participation of all the major government ministries. This

may involve the formation of joint boards (with representation of government, industry, labour and consumer associations).

174. Increased cooperation would help achieve some cost efficiencies and economies of scale through standardization and through "bulk purchasing" arrangements by "closed user groups". User organizations, having contributed their requirements to the aggregated demand, will gain access to networks or facilities at lower costs than they could have independently. In addition, users, based on their large aggregate demands, may be able to negotiate cheaper rates for higher capacity networks and more sophisticated facilities, allowing them collectively to move ahead more rapidly. Agencies in sectors of public concern should consider aggregating their demand for telecommunication networks and services on a regional basis and presenting these to national and regional providers. The purchasing, sharing and management of networks and services might be carried out by a common service agency or, a "broker", acting on behalf of the joint interests of member countries or entities of public concern within a region.

175. In addition, regional cooperation could be important in giving developing countries and specific user groups leverage to influence the direction of standards and content. For example, user groups and governments should cooperate in exercising pressure on WWW browser producers to support easier access to information in their own languages, starting with the most widely used ones such as Chinese, French, Hindi, Russian and Spanish. A better organized market of users would help encourage and, at the same time direct, entrepreneurs to produce relevant software, information and services for the public sector.

176. Finally, cooperation will be critical in resolving conflicts between national legislation and International Law related to sovereignty over cyberspace, including questions of intellectual property rights concerning electronic works and their dissemination.

177. For all the above areas, Governments should make strong efforts to support not only international and regional cooperation but also local cooperation, since it is only through an approach taking account of "grass-roots" needs that developing countries can fully benefit form ICTs. As an enabling step, they should seek to facilitate Internet and other ICT connections among the various national entities concerned with progress towards an Information Society.

REFERENCES

Australian Broadcasting Authority (ABA). *Investigation into the Content of On-line Services: Report to the Minister for Communications and the Arts*. Sidney: ABA, 1996 (ISBN. 0-642-25086). Available at http://www.dca.gov.au/aba/hpcov.htm

de Cuellar, Javier Perez. *Our Creative Diversity. Report of the World Commission on Culture and Development*. Paris: UNESCO, 1995.

Hopkinson, Belinda (ed.). *Information Technologies for Newspaper Publishing in Asia and the Pacific*. Paris: UNESCO Publishing, 1996 ('Communication and Development' Series 3).

International Council of Scientific Unions (ICSU) Press and UNESCO. *Electronic publishing in Science. Proceedings of the Joint ICSU Press/UNESCO Experts Conference, Paris, February 1996*. Paris: ICSU Press, 1996 (ISBN 0-930357-37-X).
Available at http://www.thomson.com:8066/icsu/Information/icsu.html

ITU. *World Telecommunication Development Report*. Geneva: ITU, 1994.

ITU and UNESCO. *The Right to Communicate - At What Price? Economic Constraints to the Effective Use of Telecommunications in Education, Science, Culture and in the Circulation of Information*. Paris: UNESCO, May 1995 (CII-95/WS/2).

McKinsey & Company, Inc. (attention Mr. Michael Nevens). *Connecting All of America's K-12 Schools to the National Information Infrastructure*. Report developed for the U.S. National Information Infrastructure Advisory Council (NIIAC). Palo Alto, California: McKinsey and Company, Inc., 1996.

ORBICOM (UNESCO Chairs in Communications). *Board of Directors and Committees, Montreal, June 1996. Report*. Montreal: ORBICOM Secretariat (Université du Québec à Montréal, C.P. 8888, Station Centre-ville), 1996.

d'Orville, Hans. *Technology Revolution Study: Communications and Knowledge-based Technologies for Sustainable Human Development*. Report to the Assistant Administrator and Director, Bureau for Policy and Programme Support (BPPS). New York: United Nations Development Programme (UNDP), 30 April 1996. Available at http://www.undp.org/undp/comm/index.html

Postman, Neil. *Technopoly: The Surrender of Culture to Technology*. New York: Alfred A. Knopf, 1992.

Ranganathan Centre for Information Studies (RCIS). *Proceedings of the Asia-Pacific Regional Seminar on Information Technology for Newspaper Publishing, 11-14 April 1995, Madras, India*. Madras: RCIS, 1995 (Available from UNESCO, Information and Informatics Division).

UNECA. *Africa's Information Society Initiative (AISI): An Action Framework to Build Africa's Information and Communication Infrastructure.* Addis Ababa: UNECA, 24 April 1996 (E/ECA/CM.2/6).

UNESCO. *The Challenges of the Information Highways.* Paris: UNESCO, 16 August 1996 (150 EX/15).

UNESCO. *FEMMED-WOMMED* newsletter. Autumn 1996, No. 1. Paris: UNESCO (Communication Division).

UNESCO. *International UNESCO Symposium on Copyright and Communication in the Information Society. Madrid, 11-14 March 1996, Final Report.* Paris: UNESCO, 1996 (CLT.06/WS/8).

UNESCO. *Second International Congress on Education and Informatics, Moscow, 1-5 July 1996. Final Report.* Paris: UNESCO, 1996 (in preparation).

UNESCO. *Telecommunications for Protection of the Environment: The Role of UNESCO.* Paper presented at the International Symposium on the Role of Telecommunication and Information Technology in the Protection of the Environment, Tunis, 17-19 April 1996.

UNESCO. *UNESCO and an Information Society for All: A Position Paper.* Paris: UNESCO May, 1996 (CII-96/WS/4). Available at http://www.unesco.org/cii/telematics/gis.htm

UNESCO. *The Use of Electronic Information Technologies in Open and Distance Education: Prospects and Policy Considerations. Discussion Document, Consultation in Distance Education and Information Technologies, Paris, 20-22 September 1994.* Paris: UNESCO, 13 September 1994 (UNESCO/CII).

Willis, Barry (ed.). *Distance Education: Strategies and Tools.* Englewood Cliffs, NJ: Educational Technology Publications, 1994.

Zenor, Stanley. "Developing an Electronic Information Access Policy." *TechTrends for Leaders in Education and Training: The Magazine of the Association for Educational Communications and Technology.* March 1996. Vol.41 No.2.